

phase selected from the group consisting of a  $\gamma$  phase, a  $\kappa$  phase, and a  $\mu$  phase.

13. A free-cutting copper alloy which comprises 70 to 80 percent, by weight, of copper; 1.8 to 3.5 percent, by weight, of silicon; 0.02 to 0.4 percent, by weight, of lead; optionally, at least one element selected from among 1.0 to 3.5 percent, by weight, of aluminum, and 0.02 to 0.25 percent, by weight, of phosphorus; optionally, one element selected from among 0.02 to 0.4 percent, by weight, of bismuth, 0.02 to 0.4 percent, by weight, of tellurium, and 0.02 to 0.4 percent, by weight, of selenium; and the remaining percent, by weight, of zinc, wherein the percent by weight of copper, silicon, aluminum and phosphorus in the copper alloy satisfy the relationship

$$60 \leq X - 3Y + aZ + bW \leq 70,$$

wherein

X is the percent, by weight, of copper,

Y is the percent, by weight, of silicon,

Z is the percent, by weight, of aluminum,

W is the percent, by weight, of phosphorus,

a is -2, and

b is -3; and

the copper alloy has a metal construction comprising multiple phases integrated to form a composite phase, wherein the composite phase is an  $\alpha$  phase matrix having a total phase area comprising not more than 5% of a  $\beta$  phase, and 5-70% of the total phase area is provided by at least one phase selected from the group consisting of a  $\gamma$  phase, a  $\kappa$  phase, and a  $\mu$  phase.

14. A free-cutting copper alloy which comprises 69 to 79 percent, by weight, of copper; 2.0 to 4.0 percent, by weight, of silicon; 0.02 to 0.4 percent, by weight, of lead; 0.1 to 1.5 percent, by weight, of aluminum;

0.02 to 0.25 percent, by weight, of phosphorus; optionally, at least one element selected from among 0.02 to 0.4 percent, by weight, of chromium and 0.02 to 0.4 percent by weight of titanium; optionally, one element selected from among 0.02 to 0.4 percent, by weight, of bismuth, 0.02 to 0.4 percent, by weight, of tellurium and 0.02 to 0.4 percent, by weight, of selenium; and the remaining percent, by weight, of zinc, wherein the percent by weight of copper, silicon, aluminum, phosphorous and chromium in the copper alloy satisfy the relationship

$$60 \leq X - 3Y + aZ + bW + cV \leq 70,$$

wherein

X is the percent, by weight, of copper,

Y is the percent, by weight, of silicon,

Z is the percent, by weight, of aluminum,

W is the percent, by weight, of phosphorous,

V is the percent, by weight, of chromium,

a is -2,

b is -3, and

c is 2; and

the copper alloy has a metal construction comprising multiple phases integrated to form a composite phase, wherein the composite phase is an  $\alpha$  phase matrix having a total phase area comprising not more than 5% of a  $\beta$  phase, and 5-70% of the total phase area is provided by at least one phase selected from the group consisting of a  $\gamma$  phase, a  $\kappa$  phase, and a  $\mu$  phase.